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## PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).

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<input type="checkbox"/> Additional inventors are being named on the _____ separately numbered sheets attached hereto					
TITLE OF THE INVENTION (280 characters max)					
DLP SPOKE LIGHT MOTION ARTIFACT COMPENSATION					
CORRESPONDENCE ADDRESS					
Direct all correspondence to:					
<input type="checkbox"/> Customer Number		<input type="text"/>		Place Customer Number Bar Code Label here	
OR Type Customer Number here					
<input checked="" type="checkbox"/> Firm or Individual Name		JOSEPH S. TRIPOLI, THOMSON MULTIMEDIA LICENSING INC.			
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ENCLOSED APPLICATION PARTS (check all that apply)					
<input checked="" type="checkbox"/> Specification Number of Pages		3		<input type="checkbox"/> CD(s), Number	
<input checked="" type="checkbox"/> Drawing(s) Number of Sheets		1		<input type="checkbox"/> Other (specify)	
<input type="checkbox"/> Application Data Sheet. See 37 CFR 1.76					
METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT (check one)					
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27.					
<input type="checkbox"/> A check or money order is enclosed to cover the filing fees					
<input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number:				FILING FEE AMOUNT (\$)	
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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.					
<input checked="" type="checkbox"/> No.					
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Respectfully submitted,  
SIGNATURE

Date July 30, 2003

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28,234

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Docket Number:

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## DLP SPOKE LIGHT MOTION ARTIFACT COMPENSATION

Spokes" can be turned on to make bright pixels under certain conditions, in a DLP display. Compensating reductions in the non-spoke turn-on time is needed in order to make the right pixel brightness. In order to minimize motion artifacts, the durations of these compensating reductions are matched to the spoke light durations and placed in time as close to the spokes being compensated as possible.

When spoke light recovery is used without proper compensation, there is a severe motion artifact usually known as dynamic contouring in portions of the image which have a brightness at the spoke activation level.

In the past, as far as can be determined, the artifact was tolerated. The weakness in this is a poorer appearing display occasionally.

In a typical DLP TV set application, a single digital micromirror device (DMD) is used in combination with a color wheel to implement a color sequential display. In order to minimize the color breakup artifact of the sequential display the color sequence is shown multiple times per incoming picture. Thus the color wheel must change the DMD illumination color up to 15 times per frame (60Hz frame rate). In the first planned Thomson TV set product the illumination color is changed 12 times, making a so-called 4X display (each color is displayed 4 times per incoming picture). When the illumination color is in transition from one color primary to the next color primary, this transition time is called a spoke. Normally, this time is not utilized by the display because one cannot easily make a saturated color with this "mixed" light. However, the TI DLP system has an option they call "spoke light recapture" (SLR) which can, under certain conditions, use some spokes' light, making a significantly brighter peak white object possible. Because the color during the spoke is constantly changing, in order to get consistent color rendition a spoke is used in its entirety or not at all. Furthermore, the typical application uses three spokes of different colors at a time, or not at all. This amounts to a large amount of added white light, typically about 9% of full non-spoke time. This light is added at a threshold brightness state, at approximately 60% of full brightness. Below this threshold, spokes are turned off.

Thus, when brightness increases from just below the threshold up to equal to the threshold, the spokes are turned on. In order to not have a large discontinuity in the brightness characteristic there needs to be a corresponding reduction in the non-spoke light so that the resultant brightness increase is only one least-significant-bit worth as wanted.

If this corresponding reduction is implemented at a very different time(s) in the picture period than that occupied by the turned-on spokes, then the conditions are produced for a severe motion contouring artifact. The invention consists of placing the correct amount of compensating reduction in the non-spoke segments immediately before and after the spoke being compensated, for every spoke that is activated.

Examples will now be given.

Figure 1 shows an embodiment of the invention showing the white-only brightness characteristic of all the colored segments with the spokes disabled. If the spokes would be enabled, three different colored spokes (out of 12) would be turned on at state 150 and higher. The zeros in the table below the solid line represent the spokes that would be turned on. Six zeros are used to represent three spokes because each spoke has two color primary additive components which need to be properly compensated. The numbers in the table are the sum of the pulses that are activated within each color segment, in units of least significant bits (LSB's), out of 255 maximum.

This spoke-off characteristic is employed by the SLR system when the spokes are activated, and is important for the proper spoke compensation. If this characteristic is not properly constructed, the invention is not properly implemented and the artifact will not be optimally reduced.

Figure 2 shows the white-only brightness characteristic with SLR turned on. The spoke design parameters are such that each spoke contains 8.5 LSB of each of the two constituent primary colors. Optimal compensation would require the non-spoke compensation on each side of a spoke to equal 8LSB in order to compensate

that spoke. Since some segments have an activated spoke both before and after that segment, the compensation for that segment should be 16LSB, total.

The most significant thing to note in Figure 2 is the transition from brightness state 149 to state 150. Three spokes are switched on in columns 20,21,23,24,26, and 27. In order to compensate these spokes, the non-spoke light from 16LSB lower than state 149 is utilized, namely from state 133, as shown by the number in parentheses next to the brightness state column. The blue light component of the first spoke (column 20) is optimally compensated by an 8LSB drop in the blue light of column 19. The green light component of the first spoke (column 21) plus the green light component of the second spoke (column 23) is partially compensated for by the 19LSB drop in the green light of column 22. The red light component of the second spoke (column 24) and the red light component of the third spoke (column 26) is partially compensated for by the 19LSB drop in the red light of column 25. The blue light component of the third spoke (column 27) is optimally compensated for by the 8LSB drop in the blue light of column 28. The motion compensation for these three spokes is good, but not perfect. The non-motion compensation is ideal as shown by the equivalent brightness value of column 36, which is 150 as desired.

It is important to note that the figures are given for pure white objects. In the DLP system SLR activation for a specific pixel in a specific picture period depends upon the brightness and color saturation of the pixel. As deduced from light output pulse measurements, spokes are not activated unless all three primary colors are above the threshold value. Thus, if a moving object has a non-saturated bright color, spokes can get activated when one or two of the primary colors are brighter than the threshold. For this reason, it is helpful if the compensation effects are optimized for brightness values somewhat above the threshold, as well as at the threshold, for the three primary color drive characteristics. Examination of Figure 1 shows that the compensation is still fairly good for brightness values up to 161. Looking at the segment brightnesses 16 brightness states below the state being examined and looking at the individual segment differences determine this. Since bright objects are often not pure white this could be important in reducing artifacts.

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